

**WHAT IS CLAIMED IS:**

1. A biological fertilizer composition comprising:
  - (I) poultry manure;
  - 5 (II) at least one of the following:
    - (a) a first yeast cell component comprising a first plurality of yeast cells that fix nitrogen;
    - (b) a second yeast cell component comprising a second plurality of yeast cells that decompose phosphorus compounds; or
    - 10 (c) a third yeast cell component comprising a third plurality of yeast cells that decompose potassium compounds; and
  - (III) at least one of the following:
    - (d) a fourth yeast cell component comprising a fourth plurality of yeast cells that suppress the growth of pathogenic microorganisms;
    - (e) a fifth yeast cell component comprising a fifth plurality of yeast cells that degrade antibiotics; or
    - (f) a sixth yeast cell component comprising a sixth plurality of yeast cells that reduce the odor of the biological fertilizer 15 composition.
2. The biological fertilizer composition of claim 1, further comprising at least one of the following:
  - (g) a seventh yeast cell component comprising a seventh plurality of yeast cells that convert complex carbon compounds to simple carbohydrates;
  - 25 (h) an eighth yeast cell component comprising an eighth plurality of yeast cells that overproduce growth factors; or
  - (i) a ninth yeast cell component comprising a ninth plurality of yeast cells that overproduce adenosine triphosphate.
3. A biological fertilizer composition comprising:
  - (I) poultry manure;
  - 30 (II) at least one of the following:

- (a) a first yeast cell component prepared by culturing a first plurality of yeast cells in a first electromagnetic field having a frequency in the range of 840 to 916 MHz and a field strength of 10 to 200 mV/cm;
  - (b) a second yeast cell component prepared by culturing a second plurality of yeast cells in a second electromagnetic field having a frequency in the range of 300 to 500 MHz and a field strength of 10 to 300 mV/cm;
  - (c) a third yeast cell component prepared by culturing a third plurality of yeast cells in a third electromagnetic field having a frequency in the range of 190 to 285 MHz and a field strength of 10 to 200 mV/cm; and

(III) at least one of the following:

- (d) a fourth yeast cell component prepared by culturing a fourth plurality of yeast cells in a fourth electromagnetic field having a frequency in the range of 30 to 50 MHz and a field strength of 20 to 200 mV/cm;
  - (e) a fifth yeast cell component prepared by culturing a fifth plurality of yeast cells in a fifth electromagnetic field having a frequency in the range of 70 to 100 MHz and a field strength in the range of 40 to 250 mV/cm; and
  - (f) a sixth yeast cell component prepared by culturing a sixth plurality of yeast cells in a sixth electromagnetic field having a frequency in the range of 2160 to 2250 MHz and 2280 to 2380 MHz and a field strength in the range of 100 to 300 mV/cm.

4. The biological fertilizer composition of claim 3, further comprising at least one of the following:

- 30 (g) a seventh yeast cell component prepared by culturing a  
seventh plurality of yeast cells in a fourth electromagnetic  
field having a frequency in the range of to 1050 to 1160 MHz  
and a field strength of 10 to 200 mV/cm;

(h) an eighth yeast cell component prepared by culturing an  
eighth plurality of yeast cells in an eighth electromagnetic

field having a frequency in the range of 1340 to 1440 MHz and a field strength of 20 to 200 mV/cm; and

- (i) a ninth yeast cell component prepared by culturing a ninth plurality of yeast cells in a ninth electromagnetic field having a frequency in the range of 1630 to 1730 MHz and a field strength of 20 to 200 mV/cm.

5        5. The biological fertilizer composition of claim 2 or 4 wherein each yeast cell component comprises yeast cells that is from the genus of *Saccharomyces*.

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6.        6. The biological fertilizer composition of claim 2 or 4 wherein each yeast cell component separately comprises cells of a species of yeast selected from the group consisting of *Saccharomyces cerevisiae*, *Saccharomyces chevalieri*, *Saccharomyces delbrueckii*, *Saccharomyces exiguum*, *Saccharomyces fermentati*, *Saccharomyces logos*, *Saccharomyces mellis*, *Saccharomyces microellipsoides*, *Saccharomyces oviformis*, *Saccharomyces rosei*, *Saccharomyces rouxii*, *Saccharomyces sake*, *Saccharomyces uvarum Beijer*, *Saccharomyces willianus*, *Saccharomyces ludwigii*, *Saccharomyces sinenses*, and *Saccharomyces carlsbergensis*.

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7.        7. The biological fertilizer composition of claim 2 or 4 wherein each yeast cell component separately comprises cells of a strain of yeast selected from the group consisting of *Saccharomyces cerevisiae* Hansen, ACCC2034, ACCC2035, ACCC2036, ACCC2037, ACCC2038, ACCC2039, ACCC2040, ACCC2041, ACCC2042, AS2.1, AS2.4, AS2.11, AS2.14, AS2.16, AS2.56, AS2.69, AS2.70, AS2.93, AS2.98, AS2.101, AS2.109, AS2.110, AS2.112, AS2.139, AS2.173, AS2.174, AS2.182, AS2.196, AS2.242, AS2.336, AS2.346, AS2.369, AS2.374, AS2.375, AS2.379, AS2.380, AS2.382, AS2.390, AS2.393, AS2.395, AS2.396, AS2.397, AS2.398, AS2.399, AS2.400, AS2.406, AS2.408, AS2.409, AS2.413, AS2.414, AS2.415, AS2.416, AS2.422, AS2.423, AS2.430, AS2.431, AS2.432, AS2.451, AS2.452, AS2.453, AS2.458, AS2.460, AS2.463, AS2.467, AS2.486, AS2.501, AS2.502, AS2.503, AS2.504, AS2.516, AS2.535, AS2.536, AS2.558, AS2.560, AS2.561, AS2.562, AS2.576, AS2.593, AS2.594, AS2.614, AS2.620, AS2.628, AS2.631, AS2.666, AS2.982, AS2.1190, AS2.1364, AS2.1396, IFFI 1001, IFFI 1002, IFFI 1005, IFFI 1006, IFFI 1008, IFFI 1009, IFFI 1010, IFFI 1012, IFFI 1021, IFFI 1027, IFFI 1037, IFFI 1042, IFFI 1043, IFFI 1045, IFFI 1048, IFFI 1049, IFFI 1050, IFFI 1052, IFFI 1059, IFFI

- 1060, IFFI 1063, IFFI 1202, IFFI 1203, IFFI 1206, IFFI 1209, IFFI 1210, IFFI 1211, IFFI  
1212, IFFI 1213, IFFI 1215, IFFI 1220, IFFI 1221, IFFI 1224, IFFI 1247, IFFI 1248, IFFI  
1251, IFFI 1270, IFFI 1277, IFFI 1287, IFFI 1289, IFFI 1290, IFFI 1291, IFFI 1291, IFFI  
1292, IFFI 1293, IFFI 1297, IFFI 1300, IFFI 1301, IFFI 1302, IFFI 1307, IFFI 1308, IFFI  
5 1309, IFFI 1310, IFFI 1311, IFFI 1331, IFFI 1335, IFFI 1336, IFFI 1337, IFFI 1338, IFFI  
1339, IFFI 1340, IFFI 1345, IFFI 1348, IFFI 1396, IFFI 1397, IFFI 1399, IFFI 1411, IFFI  
1413; *Saccharomyces cerevisiae* Hansen Var. *ellipsoideus* (Hansen) Dekker, ACCC2043,  
AS2.2, AS2.3, AS2.8, AS2.53, AS2.163, AS2.168, AS2.483, AS2.541, AS2.559, AS2.606,  
AS2.607, AS2.611, AS2.612; *Saccharomyces chevalieri* Guilliermond, AS2.131, AS2.213;  
10 *Saccharomyces delbrueckii*, AS2.285; *Saccharomyces delbrueckii* Lindner var. *mongolicus*  
Lodder et van Rij, AS2.209, AS2.1157; *Saccharomyces exiguum* Hansen, AS2.349,  
AS2.1158; *Saccharomyces fermentati* (Saito) Lodder et van Rij, AS2.286, AS2.343;  
*Saccharomyces logos* van Laer et Denamur ex Jorgensen, AS2.156, AS2.327, AS2.335;  
*Saccharomyces mellis* Lodder et Kreger Van Rij, AS2.195; *Saccharomyces microellipsoides*  
15 Osterwalder, AS2.699; *Saccharomyces oviformis* Osterwalder, AS2.100; *Saccharomyces*  
*rosei* (Guilliermond) Lodder et kreger van Rij, AS2.287; *Saccharomyces rouxii* Boutroux,  
AS2.178, AS2.180, AS2.370, AS2.371; *Saccharomyces sake* Yabe, ACCC2045;  
*Saccharomyces carlsbergensis* Hansen, ACCC2032, ACCC2033, AS2.113, AS2.116,  
AS2.118, AS2.121, AS2.132, AS2.162, AS2.189, AS2.200, AS2.216, AS2.265, AS2.377,  
20 AS2.417, AS2.420, AS2.440, AS2.441, AS2.443, AS2.444, AS2.459, AS2.595, AS2.605,  
AS2.638, AS2.742, AS2.745, AS2.748, AS2.1042; *Saccharomyces uvarum* Beijer, IFFI  
1023, IFFI 1032, IFFI 1036, IFFI 1044, IFFI 1072, IFFI 1205, IFFI 1207; *Saccharomyces*  
*willianus* Saccardo, AS2.5, AS2.7, AS2.119, AS2.152, AS2.293, AS2.381, AS2.392,  
AS2.434, AS2.614, AS2.1189; *Saccharomyces* sp., AS2.311; *Saccharomyces ludwigii*  
25 Hansen, ACCC2044, AS2.243, AS2.508; and *Saccharomyces sinenses* Yue, AS2.1395.

8. The biological fertilizer composition of claim 2 or 4 wherein each yeast cell component comprises cells of *Saccharomyces cerevisiae*.

30 9. The biological fertilizer composition of claim 2 or 4 further comprising an inorganic substrate component.

10. The biological fertilizer composition of claim 2 or 4 wherein the inorganic substrate component comprises one or more of rock phosphate, apatite,  
35 phosphorite, sylvinit, halite, carnalitite, or potassium mica.

11. The biological fertilizer composition of claim 2 which comprises yeast cell components (a) through (f) of claim 1, and yeast cell components (g) thorough (i) of claim 2.

5 12. The biological fertilizer composition of claim 4 which comprises yeast cell components (a) through (f) of claim 3, and yeast cell components (g) thorough (i) of claim 4.

13. The biological fertilizer composition of claim 2 or 4 wherein yeast  
10 cell component (a) comprises cells of the yeast strain *Saccharomyces cerevisiae* AS2.628; yeast cell component (b) comprises cells of the yeast strain *Saccharomyces cerevisiae* AS2.628; yeast cell component (c) comprises cells of the yeast strain *Saccharomyces cerevisiae* AS2.631; yeast cell component (d) comprises cells of one or more of the following yeast strain *Saccharomyces cerevisiae* IFFI1037, IFFI1021, IFFI1051, IFFI1331,  
15 IFFI1345, or IFFI1211; yeast cell component (e) comprises cells of one or more of the following yeast strain *Saccharomyces cerevisiae* IFFI1063, IFFI1211, IFFI1340, IFFI1215, IFFI1213, IFFI1206, IFFI1211, IFFI1210, or IFFI1260; yeast cell component (f) comprises cells of one or more of the following yeast strain *Saccharomyces cerevisiae* AS2.559, AS2.423, AS2.612, AS2.53, AS2.541, or AS2.163; yeast cell component (g) comprises cells  
20 of the yeast strain *Saccharomyces cerevisiae* AS2.982; yeast cell component (h) comprises cells of the yeast strain *Saccharomyces cerevisiae* AS2.413; and yeast cell component (i) comprises cells of the yeast strain *Saccharomyces cerevisiae* AS2.536.

14. The biological fertilizer composition of claim 11 or 12 wherein yeast  
25 cell component (a) comprises cells of the yeast strain *Saccharomyces cerevisiae* AS2.628; yeast cell component (b) comprises cells of the yeast strain *Saccharomyces cerevisiae* AS2.628; yeast cell component (c) comprises cells of the yeast strain *Saccharomyces cerevisiae* AS2.631; yeast cell component (d) comprises cells of one or more of the following yeast strain *Saccharomyces cerevisiae* IFFI1037, IFFI1021, IFFI1051, IFFI1331,  
30 IFFI1345, or IFFI1211; yeast cell component (e) comprises cells of one or more of the following yeast strain *Saccharomyces cerevisiae* IFFI1063, IFFI1211, IFFI1340, IFFI1215, IFFI1213, IFFI1206, IFFI1211, IFFI1210, or IFFI1260; yeast cell component (f) comprises cells of one or more of the following yeast strain *Saccharomyces cerevisiae* AS2.559, AS2.423, AS2.612, AS2.53, AS2.541, or AS2.163; yeast cell component (g) comprises cells  
35 of the yeast strain *Saccharomyces cerevisiae* AS2.982; yeast cell component (h) comprises

cells of the yeast strain *Saccharomyces cerevisiae* AS2.413; and yeast cell component (i) comprises cells of the yeast strain *Saccharomyces cerevisiae* AS2.536.

15. The biological fertilizer composition of claim 2 or 4, wherein the  
5 pluralities of yeast cells are dried.

16. A method of producing the biological fertilizer composition of claim  
1 or 3, comprising in the order stated:

- 10 (I) preparing a mixture of yeast cells by mixing at least one yeast cell component (a), (b), or (c); with at least one yeast cell component (d), (e), or (f); and
- (II) adding poultry manure to said mixture of yeast cells to form the biological fertilizer composition.

15 17. A method of producing the biological fertilizer composition of claim  
2 or 4, comprising in the order stated:

- 20 (I) preparing a mixture of yeast cells by mixing at least one yeast cell component (a), (b), or (c); at least one yeast cell component (d), (e), or (f); with at least one yeast cell component (g), (h), or (i); and
- (II) adding poultry manure to said mixture of yeast cells to form the biological fertilizer composition.

18. The method of claim 16, wherein:

25 the first yeast cell component of (a) is prepared by culturing a first plurality of yeast cells in a first electromagnetic field or a first series of electromagnetic fields having a frequency in the range of 840 to 916 MHz and a field strength of 10 to 200 mV/cm;

30 the second yeast cell component of (b) prepared by culturing a second plurality of yeast cells in a second electromagnetic field or a second series of electromagnetic fields having a frequency in the range of 300 to 500 MHz and a field strength of 10 to 300 mV/cm;

35 the third yeast cell component of (c) is prepared by culturing a third plurality of yeast cells in a third electromagnetic field or a third series of electromagnetic

fields having a frequency in the range of 190 to 285 MHz and a field strength of 10 to 200 mV/cm;

- the fourth yeast cell component of (d) is prepared by culturing a fourth plurality of yeast cells in a fourth electromagnetic field or a fourth series of
- 5 electromagnetic fields having a frequency in the range of 30 to 50 MHz and a field strength of 20 to 200 mV/cm;

- the fifth yeast cell component of (e) is prepared by culturing a fifth plurality of yeast cells in a fifth electromagnetic field or a fifth series of electromagnetic fields having a frequency in the range of 70 to 100 MHz and a field strength in the range of
- 10 40 to 250 mV/cm; and

- the sixth yeast cell component of (f) is prepared by culturing a sixth plurality of yeast cells in a sixth electromagnetic field or a sixth series of electromagnetic fields having a frequency in the range of 2160 to 2250 MHz and 2280 to 2380 MHz and a field strength in the range of 100 to 300 mV/cm.

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19. The method of claim 17, wherein:

- the seventh yeast cell component of (g) is prepared by culturing a seventh plurality of yeast cells in a seventh electromagnetic field or a seventh series of electromagnetic fields having a frequency in the range of 1050 to 1160 MHz and a field
- 20 strength of 10 to 200 mV/cm;

- the eighth yeast cell component of (h) is prepared by culturing an eighth plurality of yeast cells in an eighth electromagnetic field or a eighth series of electromagnetic fields having a frequency in the range of 1340 to 1440 MHz and a field strength of 20 to 200 mV/cm; and

- 25 the ninth yeast cell component of (i) is prepared by culturing a ninth plurality of yeast cells in a ninth electromagnetic field or a ninth series of electromagnetic fields having a frequency in the range of 1630 to 1730 MHz and a field strength of 20 to 200 mV/cm.

- 30 20. The method of claim 16, wherein said mixture of yeast cells in step (II) is added to poultry manure, starch, and an inorganic substrate component.

21. The method of claim 17, wherein said mixture of yeast cells in step (II) is added to poultry manure, starch, and an inorganic substrate component.

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22. The method of claim 16, further comprising in the order stated:
- 5           (III) drying said biological fertilizer composition at a temperature not exceeding 65°C for a period such that the yeast cells become dormant;
- 10          (IV) drying said biological fertilizer composition at a temperature not exceeding 70°C for a period such that the water content is less than 5%;
- (V) cooling said biological fertilizer composition to ambient temperature; and
- (VI) forming granules of said biological fertilizer composition.

23. The method of claim 17, further comprising in the order stated:
- 15          (III) drying said biological fertilizer composition at a temperature not exceeding 65°C for a period such that the yeast cells become dormant;
- 20          (IV) drying said biological fertilizer composition at a temperature not exceeding 70°C for a period such that the water content is less than 5%;
- (V) cooling said biological fertilizer composition to ambient temperature; and
- (VI) forming granules of said biological fertilizer composition.

24. A method for enhancing plant growth comprising growing the plant  
25 in the presence of a biological fertilizer composition of claim 2 or 4.

26. The method of claim 23 wherein the biological fertilizer composition is applied to soil at the depth of the major root system of the plant.

30          26. The method of claim 23 wherein about 600 to 1350 kg/ha of the biological fertilizer composition is used.

27. The method of claim 23 wherein the plant is a cereal crop, vegetable crop, fruit crop, flower crop, or grass crops.

28. The method of claim 23 wherein the plant is wheat, barley, corn, soybean, rice, oat, potato, apple, orange, tomato, melon, cherry, lemon, lettuce, carrot, sugar cane, tobacco, or cotton.

5 29. The biological fertilizer composition of claim 1 or 2 wherein the yeast cells of yeast cell component (b) is capable of maintaining a balance of phosphorus compounds.

10 30. The biological fertilizer composition of claim 3 or 4 wherein the yeast cell component (b) is prepared by culturing a second plurality of yeast cells in a second electromagnetic field having a frequency in the range of 380 to 465 MHz and a field strength of 90 to 300 mV/cm.

15 31. The method of claim 18 wherein the frequency of the electromagnetic field(s) for culturing the second yeast component of (b) are in the range of 380 to 465 MHz.

32. The method of claim 19 wherein the frequency of the electromagnetic field(s) for culturing the second yeast component of (b) are in the range of 380 to 465 MHz.

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